CREATING A FRAMEWORK FOR THE SUCCESSFUL IMPLEMENTATION OF ENERGY RETROFIT PROJECTS: A DETAILED CASE STUDY OF ENERGY RETROFITS IN ATLANTA'S CHASTAIN PARK

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This thesis is dedicated to my beautiful wife Monica, without whom I would have been trapped forever in the comfortable familiarity of misery. Thank you for giving me the courage, strength, and support to pursue a life filled with abundance. I will love you always.

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NOMENCLATURE

HVAC: An acronym used to represent Heating, Ventilation, and Air Conditioning

PTAC: An acronym for Package Terminal Air Conditioner. This is a type of self-contained air conditioning unit that is typically mounted in a window or an opening in an exterior wall.

EER: Energy Efficiency Ratio. EER is used to rate air conditioning units and represents a ratio between cooling efficiency in BTU's to the electrical energy in watt-hours. A higher EER rating represents a more efficient unit.

SEER: Seasonal Energy Efficiency Ratio. SEER is similar to EER in that it is a ratio between cooling efficiency in BTU's to the electrical energy in watt-hours. As with EER, a higher SEER rating indicates a more efficient unit. SEER is a newer rating system that utilizes tests based on the normal annual usage period of a unit as opposed to the standard 95 degree temperature used to evaluate EER. Current Energy Codes in Atlanta, GA require new AC units to have a minimum rating of 12 SEER.

AFUE: Annual Fuel Utilization Efficiency. This is a ratio of the annual output energy of a gas furnace to the annual input energy of the fuel source. More efficient units utilize a complete combustion process whereby the flame and gas are sealed off completely from the outside of the unit. The result is not only a more efficient unit, but also a safer one as well.

Condensing Unit: This is the outside portion of a split air conditioning system or heat pump that contains the compressor and condensing coil.

Air handler: This is the inside portion of a split air conditioning, heat pump, and or furnace system. This unit contains the fan that is responsible for distributing heat or air conditioning throughout the building.

Closed Cell Spray Foam: A type of spray foam insulation where all of its tiny foam cells are closed and packed together. They are filled with a gas that helps the foam rise and expand and become a greater insulator. It has a higher R-value per inch than open cell foam, but is much more expensive. It is more appropriate for moist areas since it does not absorb water the way open cell foam does.

Open Cell Spray Foam: A type of spray foam insulation where the tiny cells of the foam are not completely closed. Open cell foam typically uses water as a blowing agent and can absorb water even after installation. It is less expensive than closed cell foam, but not appropriate for wet conditions.

Ductless Mini-Split: A type of air conditioning and heat pump unit that allows cooling/heating of a limited number of rooms without having to open up walls to install ductwork. Split-ductless systems have an exterior condenser and an indoor evaporator unit that houses the cooling coil, a fan, and controls, to which you can add indoor blowers. The condenser and the evaporator blowers are connected by electric wires and tubing, through which the refrigerant circulates.

INTRODUCTION

Buildings in the United States were responsible for almost 40% of the nationwide primary energy consumption in 2008. That number represents a surprising 43% more than the transportation sector and 24% more than the industrial sector. The United States accounts for 20% of the Global consumption of energy, more than any other country (China is second at 16%). These numbers represent a 50% increase in energy consumption in the US from 1980 to 2008 (DOE 2008). This trend of increasing consumption is projected by the US Department of Energy to continue into the next several decades.

Of the nearly 100 quadrillion BTU's of energy consumed in the US in 2008, 76% was created through the use of fossil fuels such as coal (DOE 2008). The usage of fossil fuels to create electricity and other energy sources resulted in the release of 2,287 million metric tons of carbon dioxide emissions in the same year (DOE 2008).

In its official report from the World Commission on Environment and Development (1987), the United Nations defined Sustainability as "development meeting the needs of the present without compromising the ability of future generations to meet their own needs." (DOE 1997). Perhaps one of the most impactful ways of furthering the cause of sustainability is through the implementation of energy retrofit programs.

This paper seeks to develop a framework for the successful implementation of energy retrofit projects in all settings, including those with the non-traditional structure and unique needs of some non-profit organizations. This will be accomplished using researched strategies for overcoming commonly associated challenges along with experiences gained through a real-life case study involving a multi-facility retrofit project in Atlanta's largest public park, Chastain Park. The framework includes the application of research based solutions for common challenges as well as specific strategies for the translation of collected data into an actual scope of work, methods for the collection of bids and selection of contractor(s), the importance of and methods for communicating amongst stakeholders, and the need for a dedicated project manager on site at all times.

CHAPTER 1

REVIEW OF LITERATURE

"Green Retrofitting" is a term used to describe the process of renovating the systems and structure of a building to improve efficiency, reduce resource consumption, and create improved indoor air quality (Alm2005). The US Green Building Council (USGBC) takes this analysis a step further and includes the premise that retrofitting does not end with the installation of energy efficient systems, but also includes continued maintenance of this equipment in order to sustain these improvements over time (USGBC 2010).

A review of literature demonstrates that the most commonly implemented strategies for energy efficiency include improved heating, ventilation, and cooling systems (HVAC), improved insulation, and lighting (Benson 2011). In making the case for energy retrofits, research has indicated that the average U.S. commercial facility has the potential to reduce energy costs by 22% through the updating of energy efficient technologies and building materials (EIA 2006). This statistic supports the notion that energy reducing building retrofits can yield many of the same results as supply-side technologies such as nuclear and wind power at a fraction of the cost (Benson 2011). However, energy retrofits are not an undisputed and commonly accepted practice amongst the commercial facilities of the U.S. A number of challenges and obstacles stand in the way of the realization of their potential. A review of case studies and other literature in the construction repertoire yields a number of commonly faced stumbling blocks. The following list of greatest common challenges details the obstacles prevalent in the existing literature regarding retrofits:

1. Soliciting financial support and funding sources for energy retrofit projects
2. Dealing with economic climate and an expectation that all corporate investments of the capital improvement nature would have a short rate of return (often expected to be five years or less)
3. Determining what retrofits are appropriate for a given application, based on the variety of factors involved in the use and condition of the facility
4. Balancing energy conservation with building systems performance
5. Avoiding "cookie cutter" retrofits and examining lifecycle costs unique to each situation and communicating them in a manner that is understandable to all stakeholders

This report will seek to examine each of these identified benefits and challenges and will apply the information gained through research to a specific case study. Throughout the paper the findings of the research review will be applied to this case study and examined for accuracy as appropriate.

One study revolving around a retrofit in a New York park indicated that the two greatest challenges in any retrofit project were 1) the adapting of green building practices to new structures and 2) soliciting financial investment in retrofit projects (Alm 2005). Another paper examining trends in increasing building efficiency cited the greatest stumbling block to be "perceived high upfront costs and uncertain returns" (Benson 2011). These seem to support a common theme in all sustainability efforts of the need for adequate funding. In a December 2009 article, David Pogue, the national director for sustainability for the widely-utilized commercial brokerage *CBRE* stated that "Increased workforce productivity ultimately holds the greatest potential savings-far greater than energy or water savings" (Lockwood 49). He supports this position with an analysis of common corporate expenditures. Utility costs in an average corporate facility are around $2.50 per square foot while the average rent is around $25 per square foot. Considering that most companies spend in the neighborhood of up to $250 per foot on employees, an improved indoor environmental quality that contributes to improved productivity could easily pay for itself. An increase in just 10% of productivity in the previous example would pay for the corporation's rent (Lockwood 49). Also, a number of non-traditional funding mechanisms exist beyond the basic corporate capital funds campaign. In fact, the government provides a large source of financial backing for energy efficient projects (Benson 2011). These funds can be found at the federal, state, and local levels and even in the private sector of energy providers (Siminovich 2001). In fact, three specific subsections of the Recovery Act are particularly relevant to the commercial real estate sector (Benson 2011). Whether through these specific government plans or through the implementation of other non-traditional funding methods such as grants, donations, and the like, funding of projects is possible in all facility arenas (US Department of Energy 2009).

Building owners and tenants often cite their perceived high upfront costs and uncertain returns as motivating factors for not pursuing energy efficiency upgrades (Benson 2011). Further, owners are not motivated by energy savings as under the terms of most conventional leases the tenant pays for utility costs (Benson 2011). One factor to be considered by these owners, however, are tax incentives for high performing buildings as well as the data that suggests that green buildings 1) yield higher rates of rent and 2) have higher overall occupancy rates (USGBC 2010). In certain situations, replacing aging HVAC systems at the end of their life cycle can yield a high rate of return. Also, lighting is an inexpensive and often fast and easy way to realize energy savings (Alm 2005).

The most common retrofit projects promote better insulation, optimized building management, and modern lighting technology (Kok 2010). However, determining which of these components and in what combination is most appropriate for any particular project can be challenging (Kok 2010). The uniqueness involved in each project can have an impact on a number of factors. For example, retrofit returns for each building are impacted by local factors such as subsidies and electricity costs. Further, a lack of holistic planning can actually render a facility less efficient, if not unsafe (Alm 2005). This can be true in situations where building humidity or ventilation are affected by changes to the building's envelope (Mudarri 2010). Adequate make-up air must be introduced in situations where the building envelope has been sealed to a level not previously attained. This is to prevent humidity issues, as well as to avoid combustion hazards (Mudarri 2010). Lighting must be selected in conjunction with the HVAC system. Lighting can impact the heat loads for the HVAC systems (to their benefit in colder climates and their detriment in warmer climates) (Siminovitch 2001). Most retrofit projects include some type of audit performed by trained professionals in the area of systems performance (Benson 2011). These audits should include some method of data collection and analysis that leads to informed decision making processes regarding the selection of building components and upgrades (Benson 2011). In addition to energy cost savings, environmental benefits are also associated with reduced consumption and can play an important factor in deciding what retrofits are best for a particular facility.

These factors can be used to help solicit support for the project, both financially and politically (Benson 2005).

Lighting, in particular, is one area in which improved performance and energy savings can be easily attained simultaneously (Siminovitch 2001). This can be achieved through a number of techniques unique to each project. For example, lighting retrofits can improve lighting quality by targeting problem areas with specific design considerations based on usage meters and photometrics (Siminovitch 2001). Photovoltaic sensors and Infrared motion detectors can be used to turn lights on and off when a space is unoccupied or illuminated by daylight. Also, newer technologies integrate many electronic components and lamps with longer life spans that lead to less maintenance and reduced costs for facilities (Siminovitch 2001). T-12 fluorescent light fixtures are the most common type of lighting found in commercial facilities. The newer T-8 technology offers 30% more light with reduced energy consumption. This is a way in which the overall wattage of light fixtures can be reduced without compromising the quantity or quality of light in a particular area (Siminovitch 2001). Each project has unique usage patterns and upgrade opportunities that should be examined and evaluated in order to create the most appropriate scope for retrofit. Similarly, newer heating and cooling systems are designed to operate more efficiently than their older counterparts. The once standard 80% AFUE gas furnace is now trumped by the 95% AFUE high efficiency furnaces. Similarly, air conditioning units are operating more efficiently than ever before and are doing so using less harmful refrigerants (Mudarri 2010). HVAC replacement can, however be more costly than lighting to replace, and must be done in a careful manner in order to achieve worthwhile results (Mudarri 2010). Systems must be professionally designed using a heat exchange and load calculation in order to be properly fitted to a build out. Ducting systems must be sized and routed appropriately in order to allow the system to function at its properly designed levels and thereby achieve its maximum efficiency (Mudarri 2010). Improperly designed ductwork (including reusing ductwork designed for a different type of system) can result in a newer potentially higher performing unit yielding results that are similar or less efficient to those of the older equipment (Mudarri 2010). Proper CFM calculations must be performed and a system designed particularly for a given space and its load requirements and level of exterior sealing.

Finally, research indicated that the projects that were most successful communicated benefits and rates of return to stakeholders in clear and quantifiable format. (Brita in pubs).These communications included projected energy savings outcomes from retrofits along with scientific test data to support work decisions. These savings should then be supported by a rate of return that was sensitive to funding sources, local incentives, building condition, and specific technology implemented (Brita in Pubs).

Gaps in Knowledge

The review of literature identified several common themes and challenges involved in the successful completion of energy retrofit projects. However, there are also some gaps that exist between the knowledge presented in the current research and the implementation in some project applications. For example, most of the research is focused on the implementation of energy efficient solutions as justified by a quick rate of return and long term savings. However, little is said with regards to completing these types of projects in a not-for-profit environment. One example would be that of a public park supported both by government funds as well as private donations. In this example, return on investment is not the primary concern, at least not from a purely financial standpoint. ROI in this case is more related to being a good steward of funds from multiple sources and making the largest impact for the good of the community and overall environment.

Also lacking in the research is specific direction on how to determine a project's most appropriate scope of work. In most cases, particularly those involving older buildings, there are a seemingly infinite number of strategies that could be included in the development of a project's scope. Determining how to prioritize those strategies and maximize the impact of limited resources, however, is a discussion that is limited mostly in present research to return on investment. Little information can be found outlining the detailed calculations and the methods for their interpretation that can lead to the development of the most effective scope that maximizes resources as well as is mindful of safety and performance needs.

Research Objective

This paper will seek to implement the strategies identified through research for the mitigation of commonly identified problems in retrofit projects while exploring additional strategies for the successful implementation of energy retrofit projects in non-profit organizations. This will be accomplished in part through the development of a comprehensive, effective, and prudent scope of work. It will seek to develop a strategy for the collection of relevant information in a potential retrofit situation and translating that information into a scope of work that reduces energy consumption, meets budgetary demands, and maintains (if not improves) overall comfort and performance of the facility. The research objectives can be defined as seeking to recommend a framework for the development of a project's scope of work that:

1. Reduces energy consumption, meets budgetary demands, and maintains (if not improves) overall comfort and performance of the facility

2. Incorporates the research based techniques for overcoming common obstacles in retrofit projects, as identified through the literature review.

3. Incorporates specific performance measures for each unique facility and utilizes the data collected to make informed decisions regarding selection of high impact strategies based on needs, project objectives, and budget.

Research Methodology

This paper will incorporate strategies identified in existing literature with a variety of techniques and information sources from an actual detailed case study involving the retrofitting of multiple buildings in an Atlanta public park. The combination of research based strategies and real life experience through the case study will be used to develop a framework for the completion of retrofit projects. The following steps will be used:

1. Complete Review of existing literature

2. Identify common obstacles and strategies for overcoming them

3. Apply information learned through literature review to Case Study

4. Evaluate the identified common challenges and strategies for their relevance to the project, adding additional challenges to the list, as appropriate.

5. Develop additional strategies to enhance present knowledge in development of a framework for implementation of retrofit projects in all settings, including those non-profit settings with special needs

Case Study Introduction

Chastain Park is located in the Northeast corner of Atlanta's Buckhead Business district. It is surrounded by upscale homes, churches, and a variety of businesses. The park itself encompasses 260 acres, the largest public park in the city of Atlanta(OCA 2011). It includes a diverse inventory of facilities which comprise the partners in the park. These include the Amphitheater, Horse Park, Arts Center, Golf Course, Swimming Pool and fitness center, multiple youth athletic facilities (including baseball, football, softball fields, and a gymnasium), tennis center with multiple tennis courts, and the Galloway School (private k-12).

The Chastain Park Conservancy is a non-profit organization formed in 2003 to provide support for the park. The volunteer organization and its board of directors are charged with implementing the park's long term Master plan (developed by the City of Atlanta) as well as providing for some of its daily maintenance and operations. In addition to their volunteer board, the Conservancy employees two full time persons, the Executive Director and the Director of Operations. They also employ a part-time

Project Background

The Chastain Park Sustainability project was made possible by a private foundation grant. The stated goal of the grant was to reduce the overall energy consumption in the park by 20%. This would be determined through a baseline established in part by the examination of actual energy usage (documented by utility bills) and then broken into categories using a modeling system that was based on the building's appliances, lighting, HVAC systems, and plumbing fixtures.

One of Atlanta's widely known consultants in the area of Green Building, Southface, was enlisted by the grant foundation to perform an energy audit on all of the buildings within the park. These audits included opportunities for improvements and estimated costs for those improvements. The audits were returned to the grant foundation who then used them as a baseline to establish the amount for the grant. These audits also served to demonstrate the feasibility of achieving the desired reductions in energy consumption (Southface 2010).

The Partners included in the project are the Arts Center, The Northside Youth Organization (Two facilities; the Dowis Office and the Gymnasium), The Golf Clubhouse, and The Horse Park. The tennis center was omitted from this project since it was recently completed in 2010 and was certified as an Earth Craft Building at that time. Similarly, the Galloway School and the Amphitheater were not included because of their own significant sources of funding and recent renovations. The director of the Chastain Park Pool facility refused participation in the project.

Unique Challenges

The model of a third party support group in Chastain park is one that is not uncommon in city parks and with large public venues designed to accommodate many different groups of people. With funding challenges for all aspects of government programs and facilities, this type of energy savings retrofit is a way in which these third party organizations(as well as government leaders) can support their parks in an exponential and lasting way.

All of the land and facilities that make up Chastain Park are owned by the city of Atlanta. However, each of the facilities (except the Chastain Arts Center) is leased to a private for-profit organization that is responsible for its operation. The one unifying organization that serves to maintain the park as a whole is the Conservancy. This situation was unique in terms of energy retrofit modeling. Although the Conservancy existed to support the park and its partners, it was not responsible for paying the utility bills for its facilities. Each lessee was responsible for their own operating costs. This situation made the retrofit process different from other organizations that are responsible for their own maintenance costs and energy bills. Since the Conservancy did not pay these routine costs, they did not stand to benefit economically from the savings of the retrofits through either monthly utility costs or routine maintenance. As such, the notions of payback potential verses upfront costs played a very different role than they would have in a traditional retrofit program. In a typical situation the organization funding the project would also be receiving the financial benefits of energy savings and could utilize those savings to complete future portions of the project. However, in this instance, there was a one-time lump sum of money that needed to be utilized to create as much of an immediate impact as possible and no portion of the savings could be considered as funding for future improvements.

One of the ways that the conservancy chose to meet the objective of making the most impact with limited funds was to utilize a competitive bid process. While an economically sound idea, this methodology posed some unintended challenges. The greatest challenge involved setting the scope of work to for contractors to bid upon. The recommendations provided by Southface as a result of their energy audits were broad opportunities, not specific methodologies. For example, the reports made recommendations such as “insulate walls” or “insulate crawlspace.” However, in talking with contractors, the Conservancy’s project manager learned that there were multiple ways in which to achieve those goals. One specific example involved insulating the attic of the Arts Center. One viable method involved using a spray foam product to encapsulate the attic. This method did the best job of sealing the space while simultaneously dealing with air leaks. However, it was more costly than the second option of using traditional insulation rolls or even a third option of blown in loose cellulose. Either of the latter two methods would have been cheaper from a material cost perspective, however, would have been much more labor intensive and less effective. The problem with the bid process was that there was a great deal of room for an individual contractor’s interpretation and no real way to get bids that were truly equivalent for comparison sake. Other complications arose in trying to anticipate consequential costs. For example, what if the HVAC ducting had to be altered when changing out an AC unit? What if the light fixtures couldn’t simply be retrofitted and needed to be replaced? Considering that the project included multiple buildings with diverse construction and needs, how much time was each contractor going to be expected to spend on site in order to gather information to prepare a bid for a job they might not even get?

To solve these problems with the bid process, a comprehensive and descriptive scope of work (SOW) was devised for each building. This SOW was not the exact and specific work that would ultimately be performed. It was, however, a reasonable representation of the type of work that was anticipated. For each of the tasks, a methodology was selected and parameters given surrounding that methodology. For example, one item stated that insulation was to be installed in a crawlspace using traditional batts and securing them to the floor joists. The SOW told the contractors to assume that the floor had no leaks and that it was a square area with a particular square footage. This was not entirely true, since there were some leaks that needed to be sealed and there may have also been some other challenges with completing this task. However, by giving all of the parameters and assumptions in the bid package, the contractors were all able to estimate the jobs using the same guidelines. The contractors appreciated this method because it was respectful of their time upfront before being selected for the job. In exchange, the project manager asserted that there would be no contracts signed obligating the conservancy to the contractor until a final scope of work and pricing was agreed upon. No change orders would be allowed until this point. The winning contractor would be expected to work with the conservancy in finalizing the details for the SOW and developing a price that was based on the same foundation as the bid package. Significant deviations in pricing during this finalizing phase would put the contractor at risk of being fired before work began. The contractors selected to bid on the project responded well to this arrangement. Their responses indicated that they felt as though it was respectful of their time and gave everyone a legitimate opportunity to compete for the work.

In contrast to the challenges created by the competitive bid process, there were some unanticipated benefits that resulted from the process as well. One such benefit involved pricing. Given the current economic climate (particularly within the construction field), the size of this job made it attractive to those faced with the potential of earning the work. Further, the large clientele base that supports the conservancy tends to be residents of the more affluent neighborhoods surrounding the park, thus making them and their homes prime candidates for the same types of energy saving renovations and retrofits involved in this project. The combination of the size of the job along with the potential for new clients made it very attractive. Since the contractors were aware that they were participating in a competitive bid process they may have returned a more competitive bid than they would have otherwise. In fact, two of the contractors included heavy donations of fees (up to 20% of overall costs) as incentives. It is believed that this effort may not have been made if the contractors were not aware that they were competing with others for the work. These return contributions allowed the conservancy to maximize its available funds for the project. In addition, the interview process for each contractor and its accompanying walk-through of the facilities resulted in a number of conversations that provided the project manager with information regarding a diverse set of experiences and techniques for meeting the challenges of the project. Finally, spending time with each contractor during the process also allowed the project manager to become familiar with the knowledge base, work ethic, communication skills, and ability to meet deadlines of each of the bidding contractors.

CHAPTER 2

CHASTAIN ARTS CENTER

The Chastain Arts Center was perhaps the most extensive portion of the overall project due to its age and level of disrepair. The two single level buildings that made up the Arts Center combine for a total square footage of approximately 18,500 square feet. They were believed to have been constructed during the first decade of the 20^{th} century, although additional evidence to support a more specific time was not available (OCA 2011). The facility included a large multi-classroom building where community arts classes of a various nature were held. Multiple areas of the building had been previously renovated at different times and two large porch areas had been enclosed. These renovations/additions were performed with little or no cohesive traits, thus leading to a building that had multiple wings with building systems that did not work in concert with one another. Further, there was no insulation of any kind present in any portion of the building. In addition to this main building, there was also a separate building connected to the Arts Center by way of a covered walkway that served as the Art Gallery. The buildings were originally almshouses (or poorhouses) for the elderly, disabled, and unemployable. The building that was being used as the gallery had originally served as the living quarters for the facility's caretakers (OCA 2011). For the purposes of this study, the two buildings will be referred to as "the Main Building" and "the Gallery".

Lighting

Most of the lighting in the facility was made up of 2x4 drop in fluorescent troffers, each with four T-12 bulbs. Most screw in type bulbs had been replaced previously with compact fluorescents. However, the track lighting in the gallery consisted of about 60 incandescent bulbs. On many site visits, vacant rooms were observed with all lights in the room illuminated for hours at a time. The on-site manager for the facility noted that he often tried to walk the building and turn off lights, but was not always able to break away from his other administrative duties to do so. He explained that often one class would end and the next class may not start for several hours later. If the instructor failed to turn off the lights, they remained on until the manager came by to turn them off or the next class arrived.

T-12 lighting is an older less efficient technology than T-8 lighting (EPA 2006). T-8 lighting not only uses less energy, but also can produce more light per bulb. A typical 4 bulb T-12 fixture can be replaced with a 2 bulb T-8 fixture with minimal (3%-10%) reduction in light output (EPA 2006). Incandescent bulbs are the oldest and most common bulbs in existence. However, they are also the least efficient. A significant percentage of their energy is converted into heat as opposed to light (EPA 2006). Replacing incandescent with CFL bulbs is an inexpensive and easy way to reduce lighting energy costs by up to 70% (EPA 2006).

Envelope and Insulation

Both Buildings were constructed on a crawlspace foundation with brick walls. Prior to this project, neither building had any insulation in the walls, ceiling, or floor. Both buildings had dropped acoustical tile ceilings that hung approximately 15" below the original plaster ceilings. The old plaster had many penetrations and missing pieces that allowed air to flow freely between the non-conditioned attic area and the conditioned spaces below since the acoustic tiles themselves were providing little insulation value (less than R-1). The roof had a ridge vent as well as vents in the soffits, allowing air and heat into the attic. The windows of the facility were old, single paned glass. They did not provide much protection from heat transfer, however, they were in good shape and most of the glazing was adequate. The crawlspaces had no significant mold or moisture issues that were apparent. Entry and exit doors to the building had been updated during previous renovations and were solid core steel doors with good seals.

Table 2.1 below demonstrates the heating and cooling loads as measured for the building:

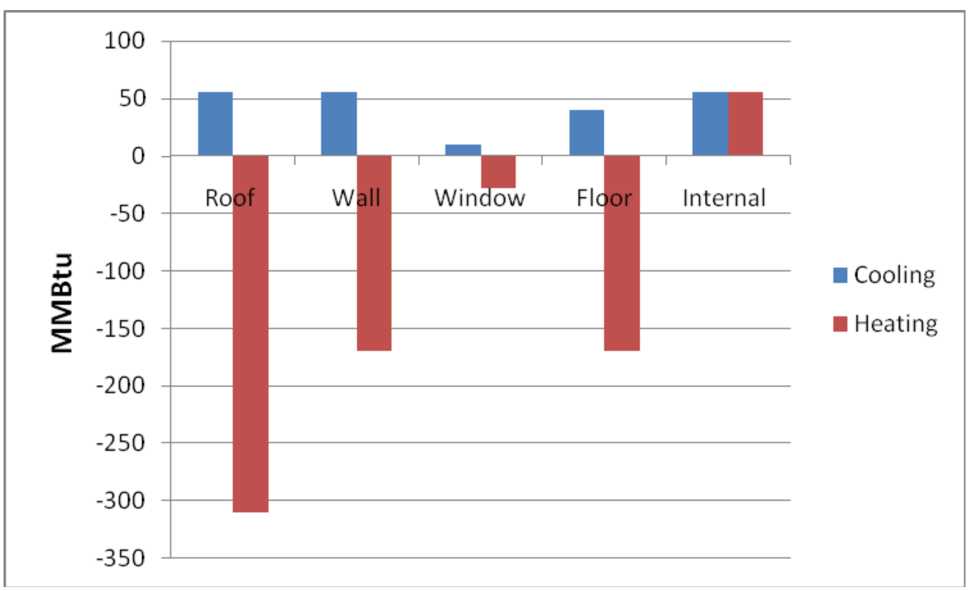
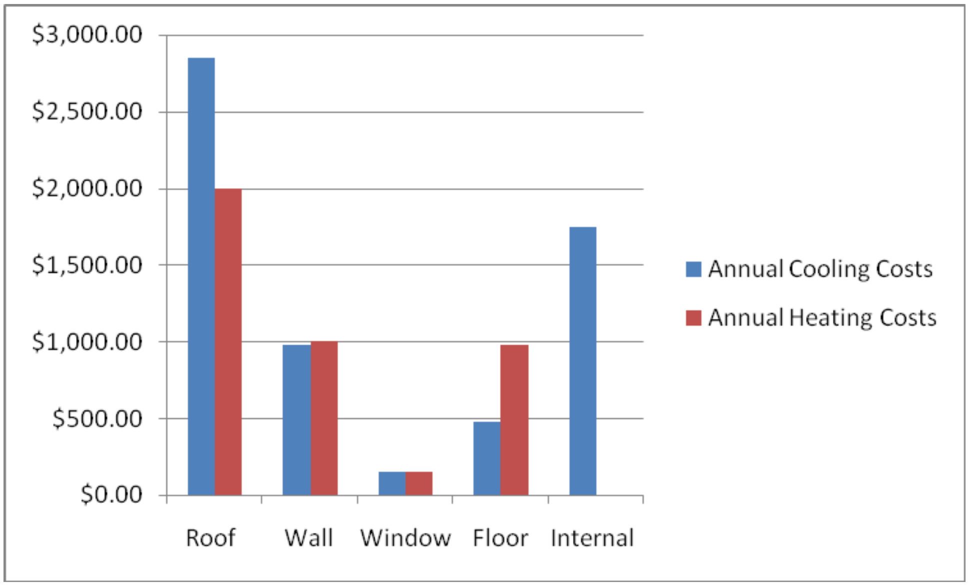


Table 2.2 below displays the estimated annual costs associated with the loads:



Examination of the heat loads and associated costs above presented several opportunities for energy improvements within the envelope of the building. The roof obviously presented the greatest challenge for both heating and air conditioning. The walls and floor presented similar heat loads, however the un-insulated walls translated to more overall cost due to their impact on the cooling loads. The walls, however, presented the greatest challenge and cost in terms of insulation techniques. Since the walls of the building were brick, the only option for insulation was to build them out on the inside and install insulation followed by drywall. This option would be high in cost and would have a long payback time. This technique also would have reduced the usable floor space of the building. However, insulating the roof (ceiling) and crawlspace (floor) was significantly easier and had a faster return on investment. Replacing windows would have been expensive and difficult and was not viewed as a realistic option given the minimal impact they seemed to have on the loads of the building.

Internal heat was mostly generated by lighting and appliances. Changing T-12 and incandescent fixtures for more efficient T-8 and Compact Fluorescents (CFL) would not only reduce the energy consumed by the lights themselves, but also reduce the amount of heat that the air conditioner needed to remove in the warm months. This would have a slightly negative effect on the cool months when the internal heat reduced the work done by the furnaces. The negative impacts of this additional heat during the summer, however, significantly outweighed its benefit in the winter.

Heating, Ventilation, and Air Conditioning (HVAC)

The HVAC systems for these two buildings were perhaps the most poorly and non-comprehensively designed component of their systems. The gallery (which once served as a living quarters) still had the original ductwork that existed prior to a 1970's renovation that removed most of the building's interior walls. As such, the return plenums and supply vents were randomly scattered about the floor, with no clear sense of purpose.

The main building had 6 split systems with air handlers and gas furnaces located in the attic. These systems served different areas of the building. However, the return plenums and thermostats for these units were all located in the same hallway. This meant that the east side of the building that received the most heat from midday sunlight was controlled by a thermostat receiving the same feedback as the units on the opposite (shaded) side of the building. The location of the returns in the hallway also meant that when the solid classroom doors were closed there was no air circulated out of the classrooms, preventing the air exchange necessary for the air conditioning to work properly and contributing to a negative indoor air quality.

Climate control for the former front porch area of the building, (now a ceramics studio) was provided by two outside package units. The area that was formerly the rear porch of the building was being supplemented through the use of a PTAC window unit.

Table 2.3 Arts Center HVAC Inventory Prior to Renovation

System	Type	Capacity (Tons)	Age	Efficiency	Total Power (kW)	Heat Power (BTU/hr)	Heat Efficiency
Main 1	Split w/Gas	5	17 Years	9 EER	4.1	100,000	80 % AFUE
Main 2	Split w/Gas	5	17 Years	9 EER	4.1	100,000	80 % AFUE
Main 3	Split w/Gas	5	17 Years	9 EER	4.1	100,000	80 % AFUE
Main 4	Split w/Gas	5	17 Years	9 EER	4.1	100,000	80 % AFUE
Main 5	Split w/Gas	5	17 Years	9 EER	4.3	125,000	80 % AFUE
Main 6	Split w/Gas	5	17 Years	9 EER	4.1	100,000	80 % AFUE
Front Addition	Package	5	17 Years	9 EER	4.7	100,000	80 % AFUE
Front Addition	Package	5	3 Years	11.7 EER	4.3	100,000	80 % AFUE
Rear Addition	PTAC	0.5	11 Years	10 EER	0.7	NA	NA
Gallery 1	Split w/Gas	3	17 Years	9 EER	3.4	115,000	80 % AFUE
Gallery 2	Split w/Gas	4	13 Years	9 EER	3.8	120,000	80 % AFUE
Gallery 3	PTAC	1	11 Years	10 EER	1.4	NA	NA

Beyond the design flaws and piece-meal nature of the overall HVAC system in this building, an examination of the above inventory provided several energy consumption concerns. First, many of these units were at or near the end of their life cycle. The typical lifespan of a condensing unit of a split system is 15 years. The typical lifespan of the air handler is 20-25 years. Many of these units were 17+ years old, meaning that the condensers were past their useful lifetimes and the air handlers fast approaching theirs. Beyond basic functionality, the age of these units suggested that they were not operating at their original performance levels. Given the age of the systems, even performing at their optimal levels would have been quite low in terms of performance. The Georgia Energy Code requires a minimum rating of 13 SEER for new units (Georgia 2011). The peak performance of the existing units when they were new would have fallen around 10 SEER, far short of the current minimum energy standard.

The second problem that existed with the units was that they all functioned through the usage of R-22 refrigerant, a CFC based product banned under the Montreal Protocol that has been gradually phased out through the EPA Clean Air Act. Production of this refrigerant was halted in the United States in 1996 and production of equipment that uses CFC's (such as R-22) was halted in 2010 (EPA 2010). Stockpiles of R-22 refrigerant and part are expected to continue to become more scarce and expensive and units that fail will have few options in terms of repair (EPA 2012).

Finally, the furnace efficiency on existing units was 80%, meaning that 20% of the furnace's heat production and energy usage was wasted through fumes exhausted through the flue pipe. Newer units can achieve as much as 95% efficiency and are safer due to the more complete and sealed combustion (Air 2009).

Scope of Work

After careful review and examination of many scenarios, a scope of work was decided upon for the Arts Center. Unfortunately, budget constraints and the significant level of need in this facility did not allow for the inclusion of all critical components. Rather than continuing the building's history of piece-milling repairs, it was decided to focus all efforts on the main building of the facility. It was decided that since that building experienced the most consistent use by the larger number of people it would be best to start there. It decided that if future renovations were possible through additional funding they would include the gallery. The SOW implemented in the main building is outlined below:

1. Encapsulate the attic of the main building using open cell spray foam along the roof line. This process seals leaks and insulates at the same time. The result is that the attic becomes a semi-conditioned space. This eliminates the need to repair penetrations in the plaster ceiling (above the drop ceiling) as well as the need to worry about leaks within the duct systems, since the air handlers and ducts within the attic would be brought inside of the building envelope. In addition, having these components inside the building envelope allows them to work more efficiently since they are closer to the building's temperature (Closed cell 2011).

2. Replace all furnaces with 95% AFUE units. In addition to the energy benefit of these units, this becomes a requirement since the attic was to be brought inside the building's envelope. Furnaces inside the envelope must be complete internal combustion such as those in high efficiency models.

3. Insulate the floor of the main building using closed cell spray foam. This technique would seal and insulate simultaneously and was an appropriate choice given the clean and moisture free condition of the crawlspace.

4. Redesign, resize, re-duct, balance and properly zone all of the new HVAC systems to account for the variance in building characteristics throughout the different additions of the facility. This process was completed using information gained through a manual-N load calculation model.

5. Retrofit or replace all T-12 fixtures with T-8 ballasts and bulbs. All four bulb fixtures were retrofitted to two bulbs. Eight foot T-12 fixtures were retrofitted to accommodate four foot bulbs.

LIGHTING AFTER RETROFIT

Chart 2.4 below demonstrates lighting changes and projected energy consumption:

Facility	Qty.	Fixture Type	Replacement	Annual Power Savings (kWh)*	Estimated Annual Savings (USD)**	Average Monthly Savings (USD)***
Arts Center	96	4 Bulb 4' T-12 (160w)	2 Bulb 4' T-8 (56w)	20800	$2,496.00	$208.00
Arts Center	59	2 Bulb 4' T-12 (80w)	2 Bulb 4' T-8 (56w)	2912	$349.44	$29.12
Arts Center	12	2 Bulb 8' T-12 (120w)	4 Bulb 4' T-8 (112w)	208	$24.96	$2.08

*Includes bulb wattage only, does not include additional savings from ballast

**Based on 40 Hour Week, 52 Weeks per year, and $.12 per kWh

***Annual Savings divided by 12

HVAC AFTER RETROFIT

Table 2.5 Demonstrates the Heating Loads Prior to Retrofitting

Component	Btuh/ft²	Btuh	% of load
Walls	3.3	20003	2.7
Glazing	37.6	54453	7.3
Doors	15.4	4061	0.5
Ceilings	15.5	188394	25.4
Floors	13.6	165303	22.3
Infiltration	15.1	113093	15.3
Ducts		161004	21.7
Piping		0	0
Humidification		34698	4.7
Ventilation		0	0
Adjustments		0	
Total		**741009**	**100.0**

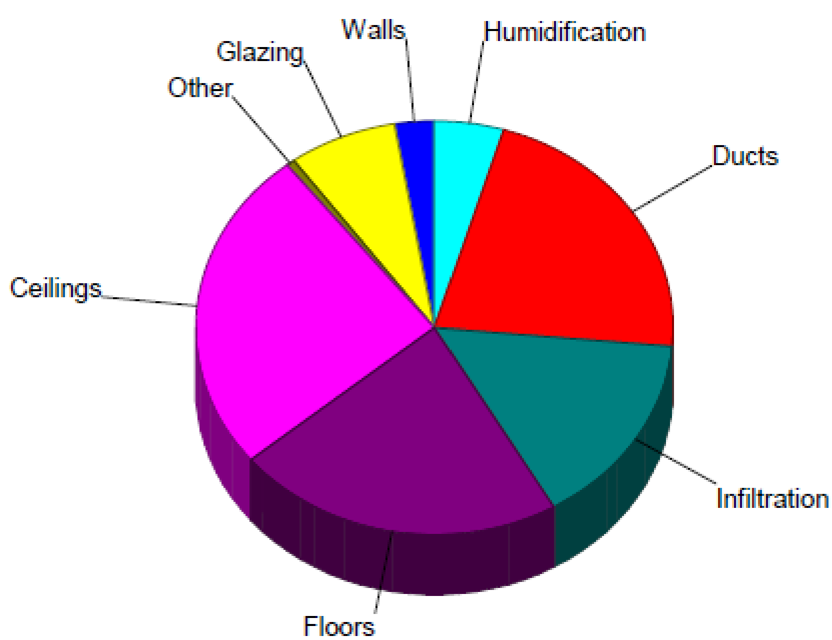


Table 2.6 Demonstrates the Heating Loads after Retrofitting

Component	Btuh/ft²	Btuh	% of load
Walls	3.3	20003	3.7
Glazing	37.6	54453	10.0
Doors	15.4	4061	0.7
Ceilings	15.5	188394	34.7
Floors	14.3	173317	31.9
Infiltration	10.4	77468	14.3
Ducts		0	0
Piping		0	0
Humidification		25411	4.7
Ventilation		0	0
Adjustments		0	
Total		**543108**	**100.0**

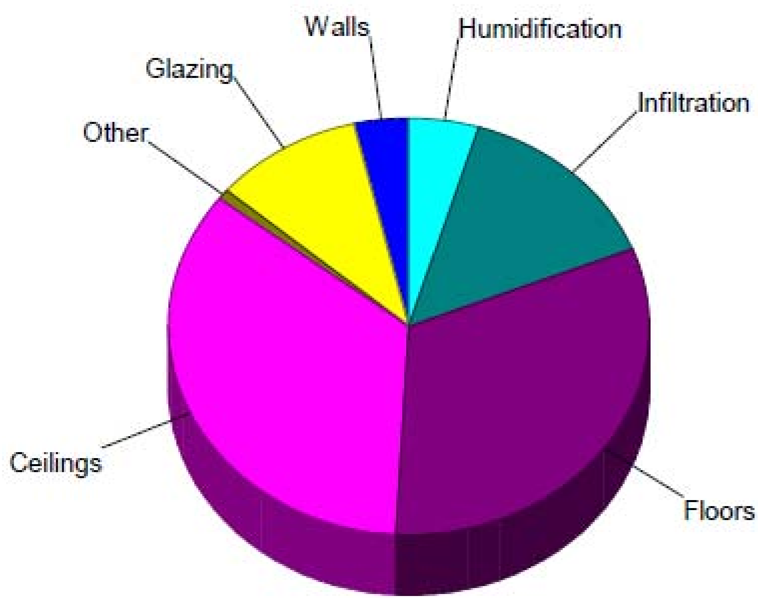


Table 2.7 Demonstrates the Cooling Loads before Retrofitting

Component	Btuh/ft²	Btuh	% of load
Walls	1.9	11186	2.1
Glazing	49.7	71988	13.4
Doors	10.1	2660	0.5
Ceilings	16.8	203634	37.9
Floors	1.7	20188	3.8
Infiltration	2.9	21826	4.1
Ducts		137473	25.6
Ventilation		0	0
Internal gains		68880	12.8
Blower		0	0
Adjustments		0	
Total		**537834**	**100.0**

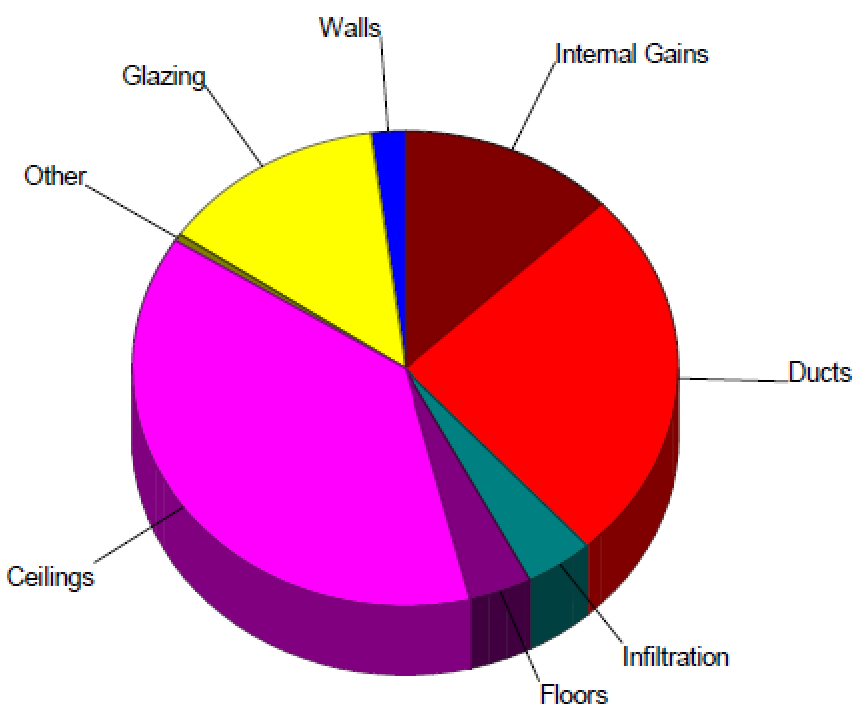
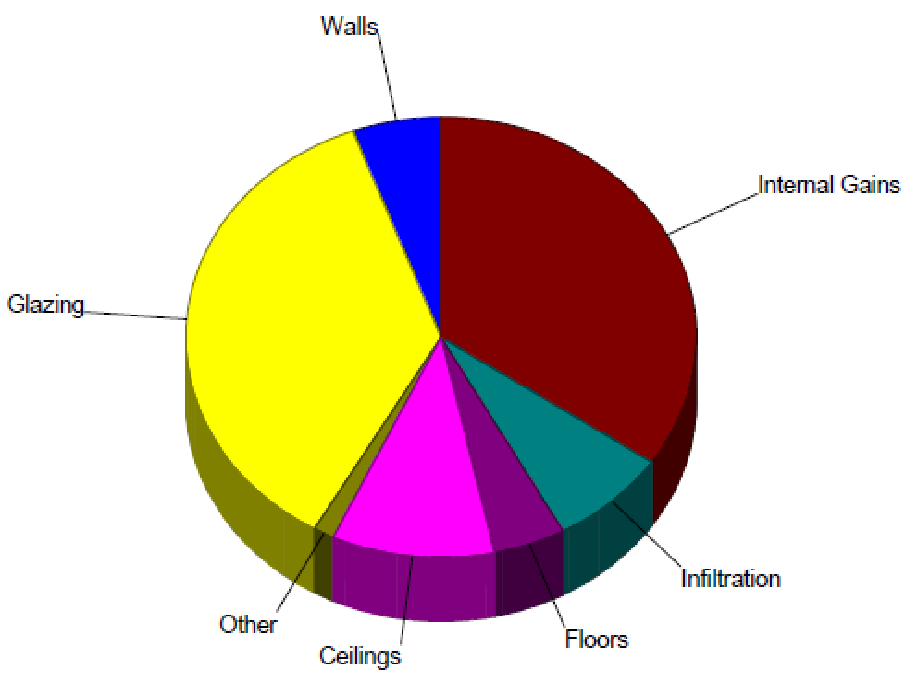


Table 2.8 Demonstrates the Cooling Loads after Retrofitting

Component	Btuh/ft²	Btuh	% of load
Walls	1.9	11186	5.6
Glazing	49.7	71988	36.1
Doors	10.1	2660	1.3
Ceilings	1.7	20458	10.3
Floors	0.7	9108	4.6
Infiltration	2.0	14986	7.5
Ducts		0	0
Ventilation		0	0
Internal gains		68880	34.6
Blower		0	0
Adjustments		0	
Total		**199266**	**100.0**



A brief analysis of the load calculations for both the heating and cooling seasons will demonstrate an improvement in both categories. These load calculations represent the amount of heating and cooling that are required to maintain a particular temperature on a particular day. They account for the amount of air leakage and heat transfer that is present in each of the categories. The Before and After models demonstrate the amount of change that resulted from the implementation of the envelope and insulation portions of the scope of work outlined previously in this chapter.

The overall amount of required heating expressed in BTUs was reduced from 741,009 BTUs to 543,108 BTUs. This represents a reduction of 197907 BTUs or approximately 27%. The distribution of the loads was also changed significantly. By design and careful consideration during the construction phase, duct leakage was reduced to near zero, a huge improvement over the original state. Although the improvement in both the leakage of the ceiling and floors were changed significantly, the redistribution of the loads after insulating the building made the importance of some loads more important and impactful than they had previously been.

Similarly, the cooling loads for the building were reduced from 537,834 BTUs to 199,266 BTUs. This constitutes a reduction in cooling needs of 338,568 BTUs; a staggering 62.9%.

These calculations and results were used to design the new HVAC systems for the Arts Center. Energy Savings from the new systems come from the following factors:

1. The reduced loads allowed for the installation of units with much smaller heating/cooling capacities

2. The new units were replacing units that were much older and less efficient by design
3. The reduced load capacities and the ability of the building to maintain temperature on its own cause the new units to work less

CHAPTER 3

NORTHSIDE YOUTH ORGANIZATION DOWIS OFFICE AND GYMNASIUM

The Northside Youth Organization (NYO)is a recreational sports organization that provides opportunities for children in the community. Their primary buildings include the Dowis office building and the Chastain Park Gymnasium. The gymnasium is used regularly throughout the calendar year and the office building is used daily by the group’s executive director (it is open 40 hours per week, Monday through Friday). The office building includes the director’s office, two bathrooms (one male, one female), and a large group meeting space. There is also a large storage area and utility shed in the basement of the building, however, this space is not conditioned.

Lighting

Most of the lighting in the Dowis office building consists of 2x4 drop in prismatic T-12 fixtures. Two characteristics stood out about the lights in this building. First, the large meeting space that was used infrequently and irregularly often had the lights turned on for hours at a time while vacant. Secondly, the stairwell that led to the basement only had a switch at the bottom of the stairs. This situation resulted in either a dangerous task of walking down the stairs in the dark to reach the light switch, or leaving the lights on all the time (resulting hours of wasted electricity usage).

The gymnasium utilized the same 2x4 T-12 fixtures as the Dowis office in its non-playing areas. However, the actual basketball court of the gym and the weight room were lit using Metal Halide (HID) fixtures. These fixtures are very energy intensive. Each fixture is 400 watts and 220 volts. Due to their design, these lights would take approximately 15 minutes from the time the switch was turned on until the lights were fully lit. In addition to the high consumption of these lights, one of the concerns discovered early in the assessments was that there was only one switch that controlled the entire gym (30 fixtures). This meant that any time the gym was being cleaned or students were coming to use the weight room all lights in the gym must be turned on. This resulted in these high intensity lights being left on for many hours at a time when lighting the full gym was not at all necessary.

HVAC

The HVAC system in the Dowis building was largely oversized for its application. The unit was a 10-ton Heat Pump system that was responsible only for cooling the top floor of the building. The greatest portion of the conditioned space was a large meeting room that was only used at certain times throughout the year. In addition to that space is the office of the executive director for the NYO, a short hallway, and two single occupancy restrooms (one male, one female). Although the meeting space is not used regularly, having only one unit to service the entire building meant that it was conditioned daily from 8:00am-4:00pm while the director worked in her office. This equated to providing air conditioning or heat to a total space of 2000 square feet when only 400 square feet was actually being used.

The NYO Gym was built in the 1970's and was not originally designed to be a conditioned space. Rooftop package units were added to the gym decades after it was built. However, no significant efforts had been made to properly seal or insulate the building for the new systems. Three large fans protruded through the exterior walls at the end of the gymnasium along with two large vent flaps at the opposite end of the gym. These were originally used for ventilation. These flaps and fans did not seal tightly and allowed large amounts of air exchange between the building and the exterior. In addition, the main entry doors of the gym opened directly into the exterior with no barrier in between. Opening the gym doors for participants or spectators to enter allowed much of the conditioned air to escape the building's envelope and outside air to enter. No insulation existed on any portion of the building's concrete walls or flat rooftop ceiling.

Scope of Work

After examining the usage patterns and areas of concerns for these two NYO facilities, the following scope of work was decided upon:

1. Retrofit all T-12 light fixtures in both buildings with T-8 fixtures. As a result of the improved efficiency resulting from the T-8 bulbs, the number of bulbs per fixture was reduced from four to two. This resulted in an approximate reduction of 3%-10%, an amount undetectable by most persons.

2. Replace the HID fixtures in the gym with T-5 HO High Bay fluorescents. Using photometric design, it was decided that 4 bulb fixtures would provide the same amount of light as the metal halides. These fixtures use approximately half the wattage of the HIDs. Also, they turn on instantly and were adaptable to occupancy sensors. Two such sensors were strategically place at the entrance of the gym and at the exit of the weight room. The system was designed so that only the first row of lights would turn on in the

3. Install a slave zone system to the HVAC system for the office of the director so that the amount of air delivered to the office was much greater than that delivered to the large meeting space. This system included a thermostat in the office that would divert the air back into the meeting room once its set temperature was satisfied. A programmable thermostat was added to the original system and programmed to maintain a minimal level of heating/cooling in the meeting space. This could be temporarily changed for meetings, but reverted back to the originally programmed schedule every two hours. The cost of reducing the size of this unit was not justified as the current unit had several expected years of service remaining. It was recommended, however that at the time of its replacement a smaller unit (approximately half the size) be put in its place. In the meantime, the programmable thermostat would be used to minimize the oversized unit's usage.

4. Thoroughly seal all unnecessary ventilation penetrations in the envelope of the building. This includes all vent fans and louvered openings.

Lighting after Retrofitting

Table 3.1 below demonstrates lighting reductions for the Dowis office and Gym:

Facility	Qty.	Fixture Type	Replacement	Annual Power Savings (kWh)	Estimated Annual Savings (USD)**	Average Monthly Savings (USD)***
Dowis Office	21	4 Bulb 4' T-12 (160w)	2 Bulb 4' T-8 (56w)	4576	$549.12	$45.76
Dowis Office	3	2 Bulb 4' T-12 (80w)	2 Bulb 4' T-8 (56w)	166.4	$19.97	$1.66
Gym	30	Metal Halide HID (400w)	6 Bulb T-5HO (324)	4742.4	$569.09	$47.42
Gym	5	Metal Halide HID (400w)	4 Bulb T-5HO (216)	1913.6	$229.63	$19.14

*Includes bulb wattage only, does not include additional savings from ballast

**Based on 40 Hour Week, 52 Weeks per year, and $.12 per kWh

***Annual Savings divided by 12

HVAC after Retrofitting

Since no major modifications to the HVAC system in this building were included in the scope of work, no Load calculations for this building were performed. The slave zone system in the Dowis office is expected to produce some minimal improvements, however its greatest benefits will be realized in the improved comfort level in the office.

CHAPTER 4

NORTH FULTON GOLF COURSE CLUBHOUSE

The North Fulton Golf Course was built in the 1940's. It is a two level masonry stone building with offices, a retail golf supply shop, and concessions upstairs and both men's and women's locker rooms downstairs. This facility's scope focused entirely on the upstairs portion of the facility, due to a planned renovation of the downstairs area (locker rooms) from another source of funds that included major demolition and replacement. The facility boasted a large stone fireplace in the center of a large pine paneling lined room that served as the retail pro shop and snack area. An acoustical tile "drop ceiling" was installed throughout the facility. At one end of the large room was an entrance to a short hallway that contained men's and women's restrooms and a large office. At the opposite end of the building were a kitchen, storage closet, and the general manager's office.

During the initial assessment of the building, it was discovered that above the acoustical tile ceiling was a cathedral ceiling, complete with huge pine beams and paneling. This had all been covered during a 1970's renovation. Above the ceiling tiles were batts of insulation. Since the ceiling tiles themselves did not provide an adequate thermal barrier, these batts provided little to no insulation for the facility. In fact, they served as collection devices for dust and other airborne contaminants. Due to the scope of work needed from the energy savings perspective, it was ultimately decided that complete removal of this drop ceiling and restoration of the building's original exposed beams would be cost neutral. This was due to the need to remove all of the existing insulation, remove the failed rooftop unit and its ducting, and replace the broken and inefficient light fixtures. The additional labor involved in removing the ceiling was compensated for by a reduction in labor to work around the ceiling grid (if left in place) and to remove the ceiling tiles carefully and replace them after the insulation was removed.

Insulation

The building envelope consisted of stone walls finished on the inside with pine paneling, store front glass doors, and single paned windows. The ceiling was acoustic tile. No insulation of any kind was present in any part of the building, with the exception of some old batts laid directly on top of the acoustic ceiling tiles. These were ineffective since the ceiling tiles offered an estimated R-value of less than 1 and no thermal barrier protection.

Lighting

Lighting throughout the building consisted entirely of T-12 fixtures, mostly 2x4 prismatic drop in troffers. Some incandescent track lighting had been installed to highlight merchandise at various places in the retail shop. Much of the light from these specific fixtures was obscured due to their excessively heavy and decorative lenses. Many of the fixtures were in disrepair and were not good candidates for simple retrofitting or re-lamp, re-ballast as was the case in other buildings. The dropped acoustic tile ceiling placed the fixtures approximately 16 feet above the floor.

HVAC

The existing HVAC unit was a 10-ton rooftop package unit that was mounted directly in the center of the building. There was a large hole in the roof where the ducting for the unit entered the building. On top of the roof was a makeshift “dog house” that had be built to deflect rain from entering the building. However, the structure was not sealed well and was a source for both outside air and rain to enter through the rooftop. Aside from being inefficient, the unit was also not doing an adequate job of heating or cooling the building. Ceiling fans were operated through all of the warm months and a separate shop style gas furnace was operated during the cold months. The entire upstairs area of the building was served by this unit which was controlled by a single thermostat in the middle of the large retail pro shop.

Scope of Work

1. Remove drop ceiling tiles and grid to expose natural wood beams and paneling
2. Replace damaged or missing pine paneling from the ends of the space. There appear to have been some louvered vents into the attic that are missing/damaged. These will be replaced and stained to match the pine.

3. Remove the present 10 ton rooftop package unit and all existing ducting from the roof. Replace all decking and roof materials necessary to cover and seal the space previously occupied by the rooftop unit.

4. Install closed cell spray foam insulation between the rafters of the roofline throughout the entire length of the building. Paint the foam insulation to match the color of the pine in the exposed pro shop area.

5. Install two 5-ton split HVAC systems (16 SEER AC, 95% AFUE Furnace), one each in the attic spaces above either end of the building. These will be ducted and zoned separately for the pro shop and office spaces. Computer modeled load calculations were utilized to design these systems.

6. Install new four foot T-8 fluorescent lighting fixtures throughout the pro shop. LED track lighting will replace current incandescent track lighting for highlighting merchandise. All wiring for the lights will be removed and reworked as needed for the new fixtures and the exposed ceiling.

7. Clean up (to the extent possible) any low voltage wiring that is exposed once the grid ceiling is removed.

Lighting after Retrofit

Chart 4.1 below demonstrates lighting changes and projected energy consumption:

Facility	Qty.	Fixture Type	Replacement	Annual Power Savings (kWh)	Estimated Annual Savings (USD)**	Average Monthly Savings (USD)***
Golf Center	40	4 Bulb 4' T-12 (160w)	2 Bulb 4' T-8 (56w)	8736	$1,048.32	$87.36
Golf Center	18	60 Watt Incandescent	13 Watt CFL	1801.28	$216.15	$18.01

*Includes bulb wattage only, does not include additional savings from ballast

**Based on 40 Hour Week, 52 Weeks per year, and $.12 per kWh, except exit signs which are 24/7/365

***Annual Savings divided by 12

HVAC after Retrofit

Table 4.2 demonstrates the Golf Center Heating Loads before Retrofitting:

Component	Btuh/ft²	Btuh	% of load
Walls	11.8	41828	20.2
Glazing	51.5	29321	14.1
Doors	0	0	0
Ceilings	7.8	27253	13.2
Floors	13.0	240	0.1
Infiltration	14.2	58444	28.2
Ducts		35893	17.3
Piping		0	0
Humidification		14264	6.9
Ventilation		0	0
Adjustments		0	
Total		**207244**	**100.0**

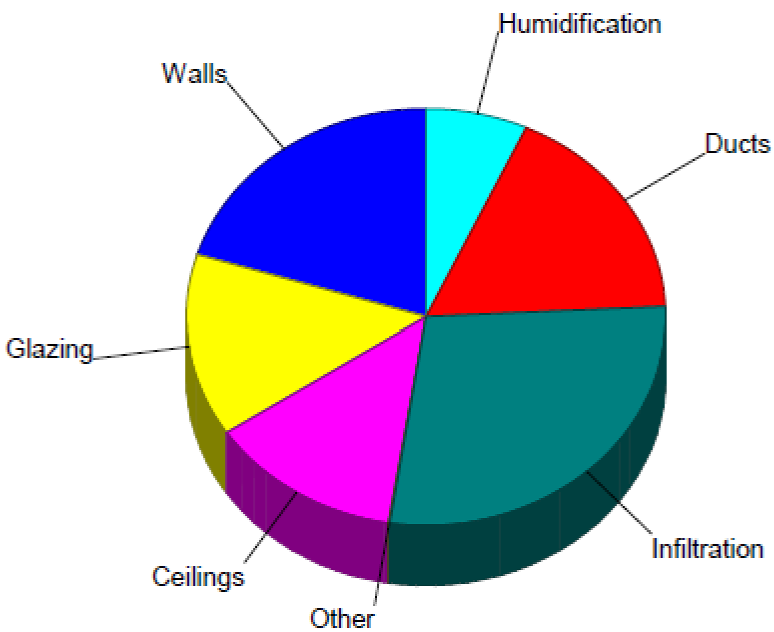


Table 4.3 demonstrates the Golf Center Heating Loads after Retrofitting:

Component	Btuh/ft²	Btuh	% of load
Walls	11.2	17826	21.2
Glazing	53.7	16088	19.1
Doors	0	0	0
Ceilings	8.0	14532	17.3
Floors	13.0	115	0.1
Infiltration	12.6	23863	28.3
Ducts		5971	7.1
Piping		0	0
Humidification		5824	6.9
Ventilation		0	0
Adjustments		0	
Total		**84219**	**100.0**

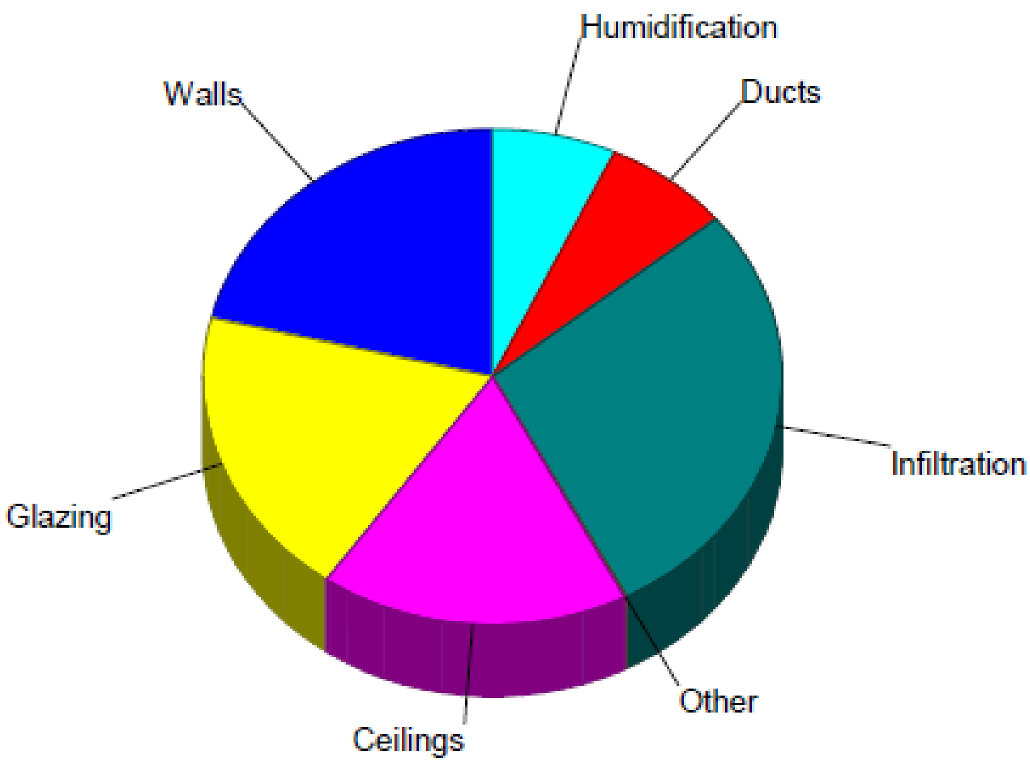


Table 4.4 demonstrates the Golf Center Cooling Loads before Retrofitting:

Component	Btuh/ft²	Btuh	% of load
Walls	7.6	26881	18.6
Glazing	55.5	31591	21.8
Doors	0	0	0
Ceilings	9.0	31587	21.8
Floors	1.8	34	0.0
Infiltration	2.7	10966	7.6
Ducts		28058	19.4
Ventilation		0	0
Internal gains		15721	10.9
Blower		0	0
Adjustments		0	
Total		**144839**	**100.0**

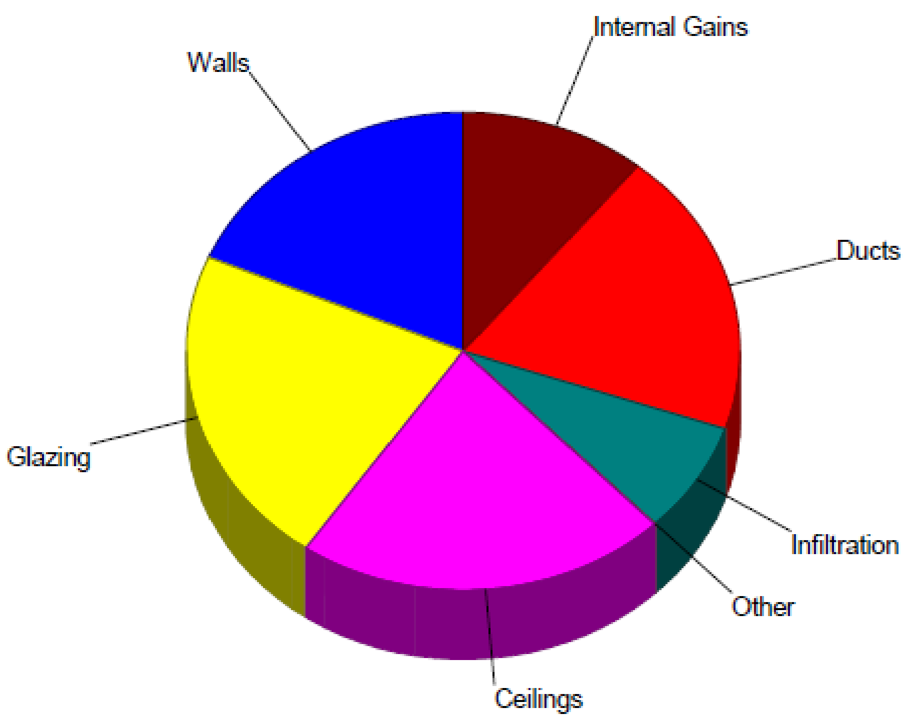
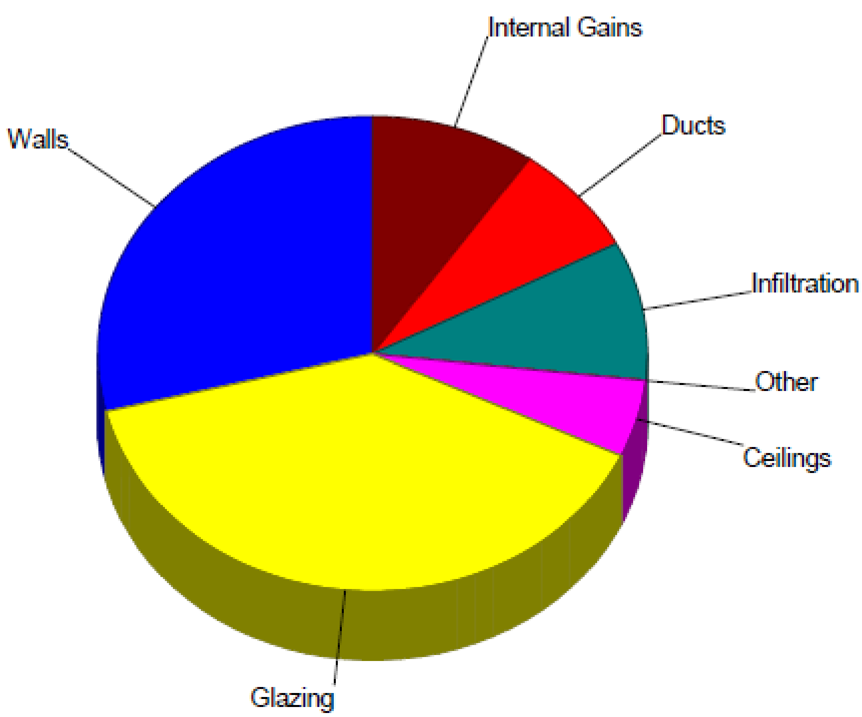


Table 4.5 demonstrates the Golf Center Cooling Loads after Retrofitting:

Component	Btuh/ft²	Btuh	% of load
Walls	6.8	10887	28.9
Glazing	49.2	14736	39.1
Doors	0	0	0
Ceilings	1.1	1992	5.3
Floors	1.8	16	0.0
Infiltration	1.9	3555	9.4
Ducts		2884	7.6
Ventilation		0	0
Internal gains		3640	9.7
Blower		0	0
Adjustments		0	
Total		**37711**	**100.0**



A brief analysis of the load calculations for both the heating and cooling seasons will demonstrate an improvement in both categories. These load calculations represent the amount of heating and cooling that are required to maintain a particular temperature on a particular day. They account for the amount of air leakage and heat transfer that is present in each of the categories. The Before and After models demonstrate the amount of change that resulted from the implementation of the envelope and insulation portions of the scope of work outlined previously in this chapter.

The overall amount of required heating expressed in BTUs was reduced from 207,244 BTUs to 84,219 BTUs. This represents a reduction of 123,025 BTUs or approximately 41%. The distribution of the loads was also changed significantly.

Similarly, the cooling loads for the building were reduced from 144,839 BTUs to 37,711 BTUs. This constitutes a reduction in cooling needs of 107,128 BTU's or approximately 73%.

These calculations and results were used to design the new HVAC systems for the Arts Center. Energy Savings from the new systems come from the following factors:

1. The reduced loads allowed for the installation of units with much smaller heating/cooling capacities
2. The new units were replacing units that were much older and less efficient by design
3. The reduced load capacities and the ability of the building to maintain temperature on its own cause the new units to work less

CHAPTER 5

CHASTAIN HORSE PARK

The Chastain horse park is comprised of multiple covered arenas, 4 horse barns with a total stall and boarding capacity of 86 horses, and a large central office facility complete with dining space and an elaborate banquet/conference room. The central facility had recently been renovated and much of the technology updated due to a flood caused by a burst pipe. As such, the primary areas identified for upgrade in this project were the four barns.

The barns were lit using old style 8' T-12 fixtures. The four barns had a total inventory of over 96 of these fixtures. The barns did have skylight inserts that offered a good deal of savings during the daylight hours, however, the lights were used a great deal in the evenings, particularly during the winter months of the year.

Another way in which significant savings were realized was through the replacement of the 24 exit signs located in the barns. These signs remain lit for every hour of every day of the year. This translates to huge savings when the 40 watt incandescent bulbs are replaced with LED bulbs that consume less than 5 watts (EPA 2006).

Scope of Work

1. Retrofit all 8 foot T-12 bulbs with two 4 foot T-8 bulbs.
2. Replace all Incandescent Exit signs with LED Exit Signs

Lighting after Retrofit

Table 5.1 demonstrates the lighting power changes:

Facility	Qty.	Fixture Type	Replacement	Annual Power Savings (kWh)	Estimated Annual Savings (USD)**	Average Monthly Savings (USD)***
Horse Park	96	2 Bulb 8' T-12 (120w)	4 Bulb 4' T-8 (112w)	1601.6	$192.19	$16.02
Horse Park	24	2 Bulb Incandescent (40w)	Integrated LED (5w)	7358.4	$883.01	$73.58

*Includes bulb wattage only, does not include additional savings from ballast

**Based on 40 Hour Week, 52 Weeks per year, and $.12 per kWh, except exit signs which are 24/7/365

***Annual Savings divided by 12

HVAC AFTER RETROFIT

There were no HVAC or Envelope modifications at the Horse Park.

CHAPTER 6

CONCLUSIONS

The initial review of literature revealed five common obstacles encountered by energy retrofit projects in both the United States and Europe. These five challenges were:

1. Soliciting financial support and funding sources for energy retrofit projects
2. Dealing with economic climate that demands that all capital investments be accompanied by a short return on investment period
3. Determining what retrofits are appropriate for a given application, based on the use and condition of the facility
4. Balancing energy conservation with building systems performance
5. Communicating complex energy and finance concepts to stakeholders with limited experience in dealing with building systems

The retrofit project in the Chastain Park case study experienced these challenges in varying degrees. Throughout the case study, application of the concepts discussed in the literature review were implemented and applied to each specific situation within the project as possible. The first two items in the list were less relevant to the project's success than items three through five. These items dealt with the development of the scope of work, and the constant communication with stakeholders, both critical components.

Challenge 1: Soliciting financial support and funding sources

In dealing with the need for financial support, Chastain Park followed the suggestions of other retrofits examined in the literature review and sought non-traditional funding methods. For this, it turned to its not-for profit Conservancy. As a 401(c)(3) organizations, the CPC was able to solicit funds from outside donors seeking to provide support to a worthwhile organization while simultaneously receiving the tax deductions associated with supporting a non-profit entity. Also, because of its status in the community and large registered membership (for the sole purpose of benevolence), it became an ideal advertising venue for the contractors involved in the project. This led to a sponsorship that brought additional funds into the project equally to a 20% reduction in the primary contractor's fees in exchange for certain advertising considerations. Finally, the conservancy was able to tap into local electricity provider rebates totaling up to $10,000 for non-profit organizations that implemented energy retrofits. Since the buildings were owned by the City of Atlanta, but most of them were leased to tenants who were responsible for their own energy bills, this type of project might not have been available were it not for the involvement of the CPC.

Challenge 2: Dealing with Expectations of short Rate of Return

In terms of return on investment, the Chastain Park project was a little different from the other projects studied through the literature. Since all of the funds for the project were raised through an outside donor, the criteria were a little less stringent than the five year period demonstrated by most of the research. In fact, the criteria established by the third party auditor employed by the grant foundation were 10 years. This criterion was also allowed to stretch somewhat for the HVAC equipment in the Arts Center and Golf Center. As discussed at the onset of this paper, consideration for the lifecycle of current equipment was taken into account in these two situations. In both facilities, the HVAC units were beyond their typical life spans and were failing on a regular basis. Updating them as a total part of the package was a sensible option.

Challenge 3: Determining appropriate retrofits

Throughout the case study, a number of considerations can be observed for the purpose of finalizing a scope of work. In fact, a significant more amount of time was taken to explore options and develop a scope of work than was actually involved in implementing the scope. The third party auditors employed by the grant foundation took months to perform their audits on each building before making recommendations. Those recommendations were then analyzed for feasibility and heat load calculations were performed. A great deal of scientific data was examined and resulting changes that would interact with other building systems were considered carefully before finalizing the actual tasks to be performed.

Challenge 4: Balancing conservation with performance

Having been identified through the research as one of the most critical components for stakeholder buy-in, making sure that the new systems performed as well or better than the old systems was a priority for everyone involved in the Chastain Project. Photometric designs were created to make certain that light distribution in areas such as the gym and golf center were not compromised in spite of the energy savings of nearly half in both venues. Heat load calculations were performed that included both before and after scenarios involving the proposed insulation and envelope changes to ensure that both temperature and humidity levels in the Arts Center remained in the comfortable levels year round. Different types of occupancy sensors were examined in all of their applications to make certain that the appropriate type of sensor was used for each application (ranging from hall sensors to motion sensors to dual mode occupancy sensors). New zones were created as appropriate in order to provide newer and better control of temperature in each of the buildings. In choosing lighting reductions, lumens were examined to make certain that no detectable loss of light would be present in any application.

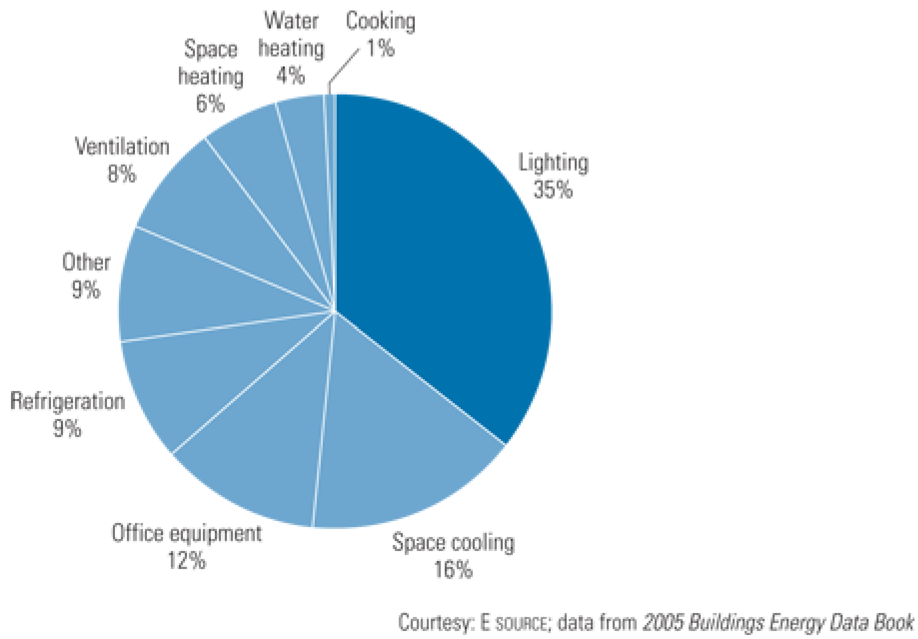
Challenge 5: Appropriate levels and types of communication

Throughout the process of auditing the buildings, finalizing a scope of work, and implementing that scope, care was taken in making certain that all of the stakeholders affected by the project were kept up to speed. Individual meetings were held with each of the building tenants as well as updates provided at the quarterly CPC board meetings. Routine written communications were provided to the grant foundation in order to keep them updated on the progress of their investment. Southface, the third party auditor employed by the grant foundation met with the project manager on multiple occasions and carefully examined the final scope of work prior to beginning implementation. Several suggestions were made and examined by Southface with regards to the scope of work. Some of these were explained as unachievable by the project team, while others were implemented. By the time construction began, Southface was satisfied with all of the project components.

In spite of the aforementioned challenges, this project turned out to be successful in multiple ways. First, projections for the lighting changes alone indicate that the initially stated goal of reducing the energy consumption across the improved buildings by at least 20% was likely met. The anticipated reduction in lighting constituted a 54% reduction in that portion of the overall energy costs. Since lighting is generally expected to account for 35% of the overall energy consumption for a commercial facility (see figure 6.1 below), a reduction of 54% of the lighting costs could reasonably be assumed to produce about a 19% reduction in overall energy costs. Similarly, the heat load calculations demonstrated an average reduction of 67.5% in cooling loads for the golf center (73%) and the Arts Center (62.9%). Figure6.1 below demonstrates that cooling and ventilation are responsible for approximately 24% of a commercial building's electrical consumption. Therefore, a reduction in this consumption by the average 67.5% translates to a 16.2% reduction in overall cooling needs. The combination of the 19% reduction in lighting and 16.2% reduction in cooling loads can be reasonably assumed to have achieved the combined 20% benchmark established at the project's onset.

It should be noted, however, that the above projections are based on averages and models. In order to do a true comparison of the energy savings attained through the energy retrofit project as a whole it would be necessary to collect multiple years of additional usage data. At a minimum, one year of data beyond the completion of the project is needed so that a comparison of corresponding months prior to and after the retrofits would be possible. A more accurate method would involve averages from at least three years prior to and three years after the renovations. This would allow for a more realistic portrait of consumption by minimizing the impact of weather anomalies in the analysis.

Table 6.1



CHAPTER 7

INFORMATION GAINED FOR SIMILAR RETROFITS

Although the Chastain Park retrofit project did experience each of the five common challenges as outlined through the literature review, one Grand Challenge did become apparent early in the project, and the potential repercussions of its failure remained throughout. This challenge involved the development of an actual specific scope of work that could be priced, implemented, and evaluated and that would drive the focus of the project. In essence, this single challenge can be viewed as the point of origin for all of the other challenges in the list. Several key components critical to the success of any retrofit project can be derived. They are as follows:

1. Ensure the development of a comprehensive scope of work that includes
   - a. input from end-users regarding their needs and desires, usage patterns, and performance expectations
   - b. opportunity for conducting an "apples to apples" bid process for contractor selection
   - c. computer modeling and other specific data from which to make informed decisions regarding performance and interaction
2. Facilitate clear communication amongst all stakeholders at the appropriate level of detail for each individual
3. Commit a qualified project manager to oversee all phases of the retrofit project and serve as the point of origin/response for all communications

Developing a Scope of Work

A great deal of planning and careful preparation went into the design stage of the project. The project manager spent literally weeks walking the buildings with different potential contractors to get ideas for meeting project goals. Once a contractor was decided upon, those walks were repeated and many different scenarios and potential complications explored. A computer model was created to simulate what effect certain changes to buildings would have on their heat loads and therefore the necessary size of HVAC units, ductwork, and power supplies. Factors that affected building comfort and environmental air quality such as humidity levels created by the size of HVAC equipment, the amount of outside fresh air brought into the building and combustion safety were all carefully examined and considered as crucial components in finalizing the scope of work. Photometric analysis was implemented to determine the current level of lighting in areas such as the gym where significant lighting changes were to be made. These analyses helped to ensure that performance was not compromised in the interest of energy savings. This component of making certain that the buildings performed as well or better in every area after the retrofit as before is a critical component that should not be overlooked. People who are not personally knowledgeable and committed to the practice of conservation are often skeptical about energy efficiency and are unwilling to sacrifice the comforts they are accustomed to for higher performing buildings. This project demonstrated that careful planning and coordination amongst specialists can design a building or system that operates more efficiently than older disjunctive systems, performs at an equal or superior level, and is minimally more expensive or even cost neutral in terms of upfront expenditures.

Fostering effective communication

As a part of the scope's development, it was important to generate conversation amongst stakeholders. Regular reports were provided to conservancy board members and grant foundation administrators (see appendix C for examples). In addition, meetings were held with each building's facility manager at multiple steps along the way. Talking with these individuals and understanding their needs for their buildings were critical. Much good insight came from these conversations. At the same time, it was important to communicate early in the process that this grant was for the purpose of energy usage reduction, not capital improvements. The project was targeting workable strategies with a good payback period and a significant impact on energy usage. While some capital improvements did result from the project (such as new lighting, restroom fixtures, and HVAC systems) these were as a result of the energy reduction process and necessary to accomplish goals. It was necessary not to manipulate the load and energy data to justify adding desired items to the scope of work that did not fit the overall objectives of the project. Conversations with building managers also provided insight into the manner in which each of them was kept abreast of relevant information. Some managers wanted to know exactly what was going on during each step of the project. Others didn't want to know anything until the conservancy had made decisions regarding scope of work and was ready to move forward with beginning work. This two way communication and attention to relationship building was critical in fostering a strong working relationship amongst all stakeholders. It would have been of no benefit for the project manager and contractor to have a perfect plan based on information that only they could understand and care about. Communicating information along the way and involving others (to the extent that they wanted to be involved) was essential in being able to sell the final plan to all stakeholders.

Retaining the services of a dedicated project manager

The role of the project manager in this case study was essential to its success. Without the services of a qualified individual who had both the organizational skills and basic understanding of MEP components, the tasks of developing the scope of work and maximizing the project's effectiveness would have been impossible. In this example, the Chastain Park Conservancy retained the services of a project manager strictly for the duration of the project. This prevented the overloading of other conservancy personnel, and ensured that a qualified individual was representing the interests of the Conservancy. Using a project manager that was employed by the contractor would have prevented all of the work that occurred prior to selecting that contractor, and would have guaranteed that all decisions were skewed towards the contractor's best interest.

In the end, it must be performance that dictates final design. Sometimes unknown or unforeseeable variables may exist that can cause a well-designed system not to perform as expected. Sometimes this may necessitate minor adjustments after installation in order to maximize performance and efficiency. However, by carefully planning and considering all reasonable elements, it is possible to minimize the opportunity for large scale oversight. Manual load calculations should be performed for all HVAC exchanges, particularly those in which building envelope or insulation is altered. An improperly sized system can adversely affect air quality and humidity levels in a manner that creates an uncomfortable and even dangerous condition. In addition to humidity concerns, it becomes important to examine the amount of fresh external air entering the building once the building envelope is sealed. ASHRAE standard 62.1 defines the percentage of fresh air that must be introduced as 15%. Also, gas furnaces must have adequate fresh air and exhaust to safely maintain combustion. Any attic or crawlspace that is encapsulated must have a 95% AFUE or better furnace with a concentric flue for combustion.

Based on the information gained through this case study one could reasonably infer that their application to similar facilities would yield positive results. The information gained through testing, exploration, and final implementation in each of the individual buildings can serve as a guide for others in looking at special considerations that must be made for each different application. The buildings in this case study were all different in age, usage, state of repair, and needs. This is common for most retrofit projects. When coupled with the experiences gained through the literature review, the methodology used in this case study and the resulting conclusions can be applied to other similar projects to get them on a path to success.

APPENDIX A: BID PACKAGE

Chastain Park Energy Conservation Project Bid Package

Thank you for taking the time to prepare a bid for consideration for this project. The enclosed list is designed to standardize the bidding process for all contractors. The scope of work described in the package is the baseline for the improvements that we are considering for each of the outlined buildings. The parameters have been designed to create a clearly defined set of tasks that can be quantifiably bid upon. The scope of work outlined is a good representation of the work that we intend to perform. It will allow us to select a contractor through a competitive bid process. Once that contractor is selected, we will work in concert with that individual to finalize the actual scope of work and make adjustments based on additional information and factors that may have been excluded from this bid package. There is a mutual understanding between us (the conservancy) and you (the contractor) that the bids you provide are for the tasks that are outlined in this package and that any adjustment to those tasks or the addition of additional tasks will result in pricing adjustments. The final scope of work and pricing will be agreed upon before any actual work has begun.

If at any point in the process you have any questions or need clarification, please do not hesitate to contact the project manager, Bryan Pope at 770-710-xxxx or via email at popebc@xxxxx.com.

We would like to receive bids as soon as possible so that we can get a contractor selected and move forward. Please discuss a timeline with the project manager if you are unable to submit a bid by September 27, 2011.

Supplemental Notes

--Include costs for Contractor securing all necessary permits

--In instances where an option is provided (specifically with regards to insulation) please provide the cost estimate for the method that you feel would be most cost effective (considering upfront costs for materials and installation…NOT overall payback).

--In instances where exhaust fans are being removed and their holes sealed, provide details for the method that you have estimated (using masonry products, sheets of steel, etc.). Again, we are looking for the method that you believe to be the most cost effective. In this situation, that means providing an adequate seal and a desirable aesthetic look for the building.

--For the purpose of all exhaust fans to be removed and sealed, assume a square shape of 50” height and 50” width. The gym contains four fans; the American Legion contains 1 fan. The walls of the gym are brick (not block) and are visible on both interior and exterior sides. The Legion Building is visible from only the outside. The exterior finish of the Legion building is wood plank siding.

--For all HVAC replacements, assume vacuuming and reusing existing refrigerant lines. Assume reusing existing ductwork. Also assume installing units that operate on R-410A refrigerant.

--Include disposal cost and method for all HVAC, Lighting, and Plumbing installations as well as materials waste disposal

--For Golf Clubhouse HVAC Replacement, assume installation of 100 feet of refrigeration line (100 feet each suction and liquid). Also assume that existing ductwork is in place and adequate for the new split system.

-- For new install of ductless mini split in Arts Center Children’s studio, include the cost of running the appropriate electrical line to the unit. Assume that the unit will be located 100 feet from the electrical panel and that there is adequate space in the panel to add the new system.

Bid Package Lighting Specifications Supplement

Dowis Office Building

--Retrofit (21) 2x4 Prizmatic T-12 fixtures to Two Bulb T-8 fixtures. These are Acoustic Drop Ceiling type fixtures.

--Replace (3) 4’ Wrap around two Bulb T-8 fixtures

Gym

--Retrofit 4 exit signs with LED lights

--Replace (30) Metal Halide High Bay Fixtures (208 volt) with 6-Bulb High Output High Bay T-5 Fluorescents with wire guards. These are presently wired to one switch through a power box that comes off of the main electrical panel. We want to split this into two switches so that half of the lights can be turned on during times such as gym cleaning when some lights are necessary, but not at full capacity.

--Replace 7 HID Ceiling lights with LED using same square light fixture. These lights are in the weight room. The ceiling is high above floor, so LED’s are desirable for their longevity as well as energy performance.

American Legion Building

--Retrofit (16) 4’ Four Bulb Wraparound light fixtures to Two Bulb T-8 wrap around fixtures.

--Retrofit 4 Exit Signs to LED

--Retrofit 3 incandescent flood bulbs to CFL

Arts Center

--Retrofit (96) 2x4 Prizmatic T-12 fixtures to Two Bulb T-8 fixtures. These are Acoustic Drop Ceiling type fixtures.

--Replace (59) Hanging fixtures with same number 2x4 Prizmatic T-8 two bulb acoustic ceiling drop in fixtures.

--Replace 72 Incandescent Spot bulbs with same number CFL spot bulbs in gallery track lighting.

--Convert (12) 8’ Two Bulb Single Pin T-12 Flourescent Strip Lights to (12) 8’ Four Bulb T-8 Strip Lights (Add Bulb contactors in the middle of the existing fixture to convert from two 8’ bulbs to four 4’ bulbs using the same fixture)

Golf Clubhouse

----Retrofit (54) 2x4 Prizmatic T-12 fixtures to Two Bulb T-8 fixtures. These are Acoustic Drop Ceiling type fixtures.

--Retrofit (16) 4' Two Bulb T-12 strip lights with Two Bulb T-8 bulbs and ballasts.

--Replace (10) 4' Two Bulb strip lights with same number and style new T-8 fixtures

--Replace (2) 4' Wrap around two bulb T-8 fixtures

--Replace (9) Incandescent Bulbs with CFL and (17) Flood lamps with CFL

--Retrofit (3) Exit Signs to LED

Horse Park

----Convert (96) 8' Two Bulb Single Pin T-12 Flourescent Strip Lights to (96) 8' Four Bulb T-8 Strip Lights (Add Bulb contactors in the middle of the existing fixture to convert from two 8' bulbs to four 4' bulbs using the same fixture)

--Retrofit (6) 4' T-12 Two Bulb strip lights to T-8 Bulbs and Ballasts.

--Retrofit (24) Exit Signs to LED

A Note about Occupancy Sensors

Please note that all occupancy sensor quantities listed on the provided spreadsheet are to be dual mode, ceiling mounted sensors.

APPENDIX B:REGULAR UPDATES

Chastain Park Sustainability Update 9-7-11

The Chastain Park Conservancy's Sustainability Retro-fit of the park's main facilities is entering its final planning stages. We have carefully reviewed the energy audits, suggested potential improvement opportunities, and budget suggestions derived from the analysis provided by Southface. In reviewing these facility assessments, we have carefully toured each facility to reconcile information and suggestions with actual facility details in order to develop a more complete understanding of the improvement opportunities identified in the reports. Further, we have met with the facility managers for each of the impacted buildings to discuss the findings of the audits and to solicit their input regarding problem areas within their facility (as related to energy consumption). At this point, I feel as though we have identified a number of high impact strategies that would offer a fast rate of return. In addition, I feel as though we also have a better understanding of what needs the facility managers feel are of the greatest importance to their end users.

The next step moving forward is to collect some actual pricing bids from potential contractors in the areas of HVAC, Lighting, and Envelope improvement. Once we have actual cost estimates based on real bids we will be able to finalize our Scope of Work for the project. This will be done by prioritizing items that will have the greatest impact on energy reduction with the fastest rate of return, are of importance to the users and operators of the facility, and constitute the most prudent distribution of the funds in our budget.

As is the case with any project using an Integrated Project Delivery model for implementation, this project is very heavy on the up-front planning side. A great deal of time has gone into the studies performed by Southface and the interpretation of those reports by myself, the conservancy, and the facility managers. However, this initial time spent working through potential problems and creating a well devised course of action for the project will most assuredly pay off over the course of the project through the more efficient and comprehensive use of available funds and resources and fewer unanticipated delays or expenditures.

<u>Chastain Park Sustainability Update 9-21-11</u>

The Chastain Park Sustainability project is progressing as expected. We are getting very close to selecting the contractors that will actually perform the work for the project. A number of contractors have been selected to bid on portions of the job. Also, three general contractors have been asked to bid on the job both as individual tasks (lighting, HVAC, and envelope sealing) as well as in a comprehensive package. All bids are due by September 27, 2011.

Once all of the bids are in place, there are several decisions that must be made in order to maximize our available funds. First, we must determine if it is more cost effective to select one contractor for the entire project, or to select individual contractors to complete portions of the project. Next, we will need to meet with our selected contractor(s) in conjunction with representatives from Southface to finalize our projected scope of work. We can then work with our partners within the park to develop a schedule that maximizes value while respecting the activities of the facilities' daily operations. Once a contractor is in place, the scope of work finalized, and a schedule made we can actually start construction.

Chastain Park Sustainability Update 10-3-11

This week marks the completion of a significant milestone in the planning stages of the Chastain Park Sustainability project. Bids have been received and reviewed and the contractors that will carry out the work have been selected. Will Clower and Southern Home Performance will be handling all of the HVAC, Envelope, Plumbing, and Masonry components of the project. Bill Shank and Georgia Lighting Technologies will be completing the lighting and electrical components of the project.

Due to the number of variables that exist in developing our final scope of work (including but not limited to: multiple methods to complete the same task, variances in equipment, unintended consequences and effects that must be considered, etc.), the bid package contained a scope of work that was representative to the actual work being considered. Much information and many strategies have been gained through the bid process. Now that we have contractors in place, we will be working to finalize the actual scope of work to be performed. We will also be meeting as a project team to identify opportunities for synergies between the multiple components of the project. In addition to interaction within building components, these meetings will include looking at opportunities that exist in scheduling, construction waste management and recycling, and similar expenses that can be shared. Once we have a strong plan in place, we will submit the scope to Southface so that it can be entered into the previously created modeling system to ensure that it meets the stated goals of the project.

As mentioned in previous updates, the green building process is very heavy in upfront planning time. That is largely because both research and experience indicate that this is the time where the most opportunities for innovation and project cost management exist. This is the time when we can have the greatest impact on both budget and project effectiveness. By anticipating interactions between building systems and potential problems up front we can develop designs that maximize energy reduction while simultaneously keeps unanticipated expenditures to a minimum. The experts that we have now secured for our team have put us one giant step closer to reaching our project goals.

Chastain Park Conservancy Sustainability Project Update 10-25-11

After weeks of planning, preparation, bidding, and careful analysis, the Chastain Park Conservancy's Energy retro-fit and Sustainability project is finally ready to break ground. The Executive Director and Project Manager met last week with both Southface and the City of Atlanta to introduce their final scope of work and obtain approval from the respective agencies. Conservancy officials met along with Will Clower of Southern Home Performance (the project's primary General Contractor) and John Bracey of Southface to review the scope of work and discuss its appropriateness in meeting project goals. Bracey indicated that he felt as though the goals would be met through the conservancy's proposed scope of work.

After receiving approval from Southface and the City of Atlanta's Parks department, contracts were signed with Southern Home Performance and Georgia Lighting Technologies to proceed with the work. Construction is scheduled to begin this Wednesday (October 26, 2012) in the Dowis Office Building. HVAC, Insulation, and Envelope work have been finalized and scheduled for all impacted buildings. Lighting pricing and design are complete for all facilities except the golf clubhouse. Once a final visit is arranged to the golf clubhouse lighting materials and fixtures will be ordered and scheduled to be installed beginning as soon as materials arrive.

Initial deposits to the appropriate contractors must be made this week in the following amounts: Southern Home Performance $66,777 and Georgia Lighting Technologies @ $30,000. These deposits will allow construction to begin immediately in areas where possible and additional special orders to be placed as needed.

Chastain Park Sustainability Update 11-17-2011

The energy retrofit/sustainability project is fast approaching the midpoint of its completion. All HVAC, insulation, and Lighting work in the Dowis Building has been completed. In addition, all 6 HVAC units in the Arts Center have been replaced. This includes furnaces (replaced with 96% AFUE), air conditioning units (replaced with 16 SEER units), all newly designed and calculated ductwork, and wiring. Foam insulation will be installed in the attic and crawlspace of the Arts Center during their fall break (November 21 through

December 2) while the building is not occupied by community members. All lighting retrofits for reusable fixtures in the Arts Center have been completed. In addition, all new EPA certified water sense toilets and faucets have been purchased and are being installed at the Arts Center.

New fixtures for the Gym, Horse Park, Legion building, and Golf Center have been ordered and are scheduled to arrive during the week of December 7. These fixtures will be installed, beginning with the Horse Park, immediately upon arrival. It is anticipated that the Arts Center will be fully completed and work will begin in the Golf Center (including HVAC, Lighting, and Insulation) on or about December 5, 2011. The work in the golf center will take between 2 and 3 weeks and will require the upstairs portion of the building to be vacated by its tenants during this time. It is anticipated that the entire sustainability project will be completed by the end of December 2011.

Chastain Park Sustainability Project Update 12/17/2011

The sustainability project at Chastain Park is quickly winding into its final phases. Most of the lighting retrofits and replacements have been completed at this time. This includes all of the lighting in the four barns at the Horse Park, replacement of the remaining fixtures at the Arts Center, replacement of the fixtures at the Gym, and replacement of the exterior fixtures at the Golf Center. The American Legion building will receive a full update of the lighting and all related wiring in the upcoming week (Dec. 19-23).

Work on the North Fulton Golf Course Clubhouse began on December 12. This project is going to accomplish not only the energy usage reduction goals but will also meet another ongoing objective of the conservancy by returning the clubhouse to its original historical state. The removal of the dropped acoustical ceiling was necessary in order to install insulation and new HVAC units into the building. As such, the cost of revealing the facility's natural pine ceiling beams was cost neutral when compared to returning the dropped ceiling after installing the energy upgrades. The first week of construction in the golf center has concluded with all demolition completed and the installation of new HVAC units well underway. The estimated completion date for the entire project is December 30,2011.

Overall, the Sustainability project has been a HUGE success and while multiple years of actual usage data would be necessary to quantify actual savings, initial calculations indicate that the goal of 20-25% reduction will be exceeded in all affected buildings. As we reach the end of the project, however, we are faced with some difficult decisions. As is typically the case in any type of significant construction or renovation, a number of unforeseeable events have occurred throughout the project that have complicated the budget. Most of these issues revolve around the age of the buildings. We have encountered problems with wiring that is not up to code, plumbing that disintegrated when touched, ceiling grids not being installed correctly, improperly vented exhaust fans, leaky roofs, etc. Our primary contractor, Southern Home Performance has been an outstanding ally, often completing additional tasks beyond their agreed upon scope of work at or below their cost to do so. Unfortunately, however, we are still faced with the need to reduce our scope of work in order to prevent a shortfall of the budget. This presents some difficult decisions that may lead to the elimination of some buildings such as the Amphitheater and Conservancy Barn from the project altogether. Also at risk are the vestibules to be added to the gym. It will be truly unfortunate to eliminate these tasks from the scope. Unfortunately, however, making certain that improvements were compliant and safe (not to mention fully functional) could not be accomplished without the subsequent impact on the project's available funds.

Chastain Park Sustainability Final Update 1-07-12

The conclusion of the first week of 2012 has also marked the conclusion of the first phase of the Chastain Park Sustainability project. The North Fulton Golf course clubhouse was concluded as scheduled on Saturday December 31, and the building turned back over to American Golf on January 1, 2012. Final punch list items were completed throughout the week on both this building and others in the park.

At the time of the writing of this update, improvements have been made in the NYO Dowis office, NYO gym, Chastain Arts Center, Chastain Horse Park, Buckhead American Legion Building, and the North Fulton Golf Course. The only buildings not addressed were the Chastain Amphitheater, the Chastain Conservancy Building, and the Pool House (as rejected by its director). It is recommended that remaining funds be utilized to pursue lighting retrofits in the dressing rooms, bathroom, and other indoor facilities of the Amphitheater as well as lighting, envelope, and HVAC improvements in the Conservancy Barn.

Future phases of the project could be directed towards improving the Gallery Building of the Chastain Arts center with attic insulation, crawlspace encapsulation, and new HVAC units as well as replacing the incandescent can lights with LEDs and occupancy sensors. During the planning phases of the project, it was decided that this building would be excluded in order to more completely address the needs of the actual arts center building, which receives more daily traffic. Since both buildings were built at the same time (circa 1900) they both presented the same level of need.

The vestibules recommended by Southface and considered during the project for the NYO gym should be bid amongst several vendors and carefully evaluated for feasibility based on return of investment. Initial pricing placed these vestibules at a cost of around $16k each due to the significant grading and concrete modifications that were necessary to make them work. This would total to a cost of around $30-35k for the pair. It may not be cost effective to implement this strategy, based on the amount of annual return and the potential for this building to be replaced prior to the realization of these savings. An alternative might be to install motion activated blowers over the doors that would create a wall of air to help prevent escape of conditioned air when the doors are opened. These would not be as effective as the vestibules, but would have a shorter payback period and would certainly be an improvement over the current situation.

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